

decision in this document. Further, the important methods steps for forming a gelatinous elastomer article were not disclosed in Chen; Chen suggested mold casting in only the vaguest terms. Nor does Chen disclose formation of pellets.

Because both the precise combination of method steps and the gel formulation of the present claimed invention are not disclosed by Chen or the other prior art references, Applicant requests reconsideration of the patent application.

Double Patenting

Applicant previously submitted a claim for priority to U.S. Patent No. 5,994,450 and its parent. Applicant provides herewith a terminal disclaimer and fee.

Respectfully submitted this 29th day of January, 2001.



Daniel McCarthy
Reg. No. 36,600
McCarthy & Sadler, LC
39 Exchange Place, #100
Salt Lake City, UT 84111
(801) 323-9399

KURARAY CO. LTD.

Material Safety Data Sheet

Date of Version: May 1, '95

Complied with OSHA's Hazard Communication Standard 29 CFR 1910.1200.
U.S. Department of Labor Occupational Safety and Health Administration

PRODUCT NAME: SEPTON-4055 MSDS No. KIP-110E

Chemical Identity

Trade Name	SEPTON-4055
Chemical Name/Synonyms	Styrene block polymer with 2-methyl-1,3-butadiene and 1,3-butadiene, hydrogenated
Formula	$\left[\text{CH}_2 - \underset{\text{C}_6\text{H}_5}{\text{CH}} \right]_k \left[\text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_2 \right]_l \left[\text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 \right]_m \left[\text{CH}_2 - \underset{\text{C}_6\text{H}_5}{\text{CH}} \right]_n$
Regulations/Transport etc.	CAS No.: 132778-07-5 UN. No.: None MITI No.: Polymer (constructed by registered block copolymers) EINECS No.: Polymer (constructed by registered monomers)

Section I

Manufacturer's Name	Kuraray Co., Ltd.
Address	Maruzen Bldg. 3-10, 2-Chome, Nihonbashi, Chuo-ku, Tokyo 103, Japan
Telephone/Fax No.	Tel: 81-3-3277-6654 / Fax: 81-3-3277-6666

Section II - Hazardous Ingredients/Identity Information

Hazardous Components	OSHA PEL	ACGIH TLV	Other Limits Recommended	%(Optional)
None known				

Section III - Physical/Chemical Characteristics

Boiling Point	None	Specific Gravity(H ₂ O=1)	0.92
Vapor Pressure(mmHg)	None	Melting Point	None
Vapor Density(AIR=1)	None	Evaporation Rate	None
Solubility in Water	None	(Butyl Acetate=1)	

Appearance and Odor

White powder, no odor

Section IV - Fire and Explosion Hazard Data

Flash point	None	Flammable Limits LEL: None	UEL: None
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Extinguishing Media

Dry chemical, water, resistant foam, or carbon dioxide should be used.

Special Fire Fighting Procedures

Wear self-contained breathing apparatus with full face piece operated in positive pressure mode.

Unusual Fire and Explosion Hazards

N/A

Section V - Reactivity Data

Stability	Unstable : Stable : *	Conditions to Avoid :
Incompatibility(Materials to Avoid)	N/A	
Hazardous Decomposition or Byproducts	N/A	
Hazardous Polymerization	May Occur : Will Not Occur: *	Conditions to Avoid :

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PRODUCT NAME : SEPTON-4055

MSDS No. KIP-110E

Section VI - Health Hazard Data

Health Hazards(Acute and Chronic) : LD₅₀(Oral,Rat);>2000mg/kg .Ames test:Negative

Carcinogenicity:N/A NTP? : N/A IARC Monographs? : N/A OSHA Regulated? : N/A

Signs and Symptoms of Exposure

N/A

Medical Conditions Generally Aggravated by Exposure

N/A

Emergency and First Aid Procedure in Each Case of Routes of Entry

In Case of Eye Contact : Gently rinse the affected eyes with clean water for at least 15 minutes. Arrange for transport to the nearest medical facility for examination and treatment by a physician as soon as possible.

In Case of Skin Contact : Wash the affected area under tepid running water using a mild soap. If irritation persists, arrange for transport to the nearest medical facility for examination and treatment by a physician.

In Case of Inhalation : Remove the victim from the contamination immediately to fresh air. Keep the victim warm and quiet. If any symptoms may appear, arrange for transport to the nearest medical facility for examination and treatment as soon as possible.

In Case of ingestion : Rinse mouth with water. Give the person one or two glasses of water, if they are conscious, try to get the victim to vomit by having the victim touch the back of their throat with a finger. If they are unconscious, don't give anything to drink and don't make them vomit. Arrange for transport to the nearest medical facility for examination and treatment as soon as possible.

Other Toxicological Information

None

Section VII - Precautions for Safe Handling and Use

Steps to Be Taken in Case Material is Released or Spilled

Take up mechanically, then place in a chemical waste containers. Ventilate area after material pick up is complete.

Waste Disposal Method

Burn in a chemical incinerator. Don't flush into the sewer. Observe local regulations, if any.

Precautions to Be Taken in Handling and Storing

Handling: Use only in the well-ventilated areas. Avoid contact skins and eyes.
Storing : Store in a cool, dry, well-ventilated location. Keep away from all possible source of ignition.

Other Precautions

None

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PRODUCT NAME: SEPTON-4055

MSDS No. KIP-110E

Section VII - Control Measures**Respiratory Protection (Specify Type)**

Keep working area well ventilated to avoid inhaling the material excessively.
Selfcontained breathing apparatus should be worn to avoid excessive exposure.

Ventilation

Local Exhaust:

Special:

Mechanical (General): Necessary

Other:

Protective Gloves

Impervious gloves are recommended to be worn.

Eye Protection

Protective eye glasses or chemical safety goggles should be worn.

Other Protective Clothing or Equipment

Impervious whole body suits are recommended to be worn

Work Hygienic Practices

Practice good personal hygiene after using this material.

Section IX - Information on Ecology**Biodegradability**

N/A

Bioaccumulation

N/A

Fish Toxicity

N/A

Other Information on Ecotoxicity

None

All data presented here in is based on actual measurements performed by Kuraray Co., Ltd. All information contained herein is presented in good faith and without warranty.

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HIGH-PERFORMANCE THERMOPLASTIC RUBBER

SEPTON TM

KURARAY CO., LTD.

B

WHAT IS "SEPTON" ?

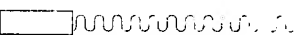
"SEPTON" is a new high performance thermoplastic rubber developed by KURARAY based on our own unique technology accumulated over the years.

"SEPTON" comprises polystyrene blocks and rubber blocks having a soft polyolefin structure, and is block copolymer with two types, diblock and triblock.


"SEPTON" shows rubber-like properties over a wide range of temperature, while upon heating "SEPTON" does show flow characteristics as a thermoplastic resin.

"SEPTON" has a versatile series of grades with own distinguishing properties from which you can choose according to your use.

MOLECULAR STRUCTURE MODEL

SEP : 

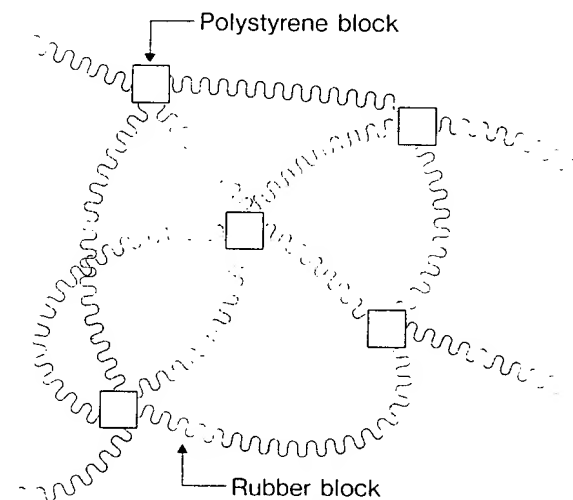
SEPS : 

 : Polystyrene block (S)

$\left(\text{C} - \underset{\text{C}_6\text{H}_5}{\text{C}} \right)_m$ Acts as a crosslinking point at a temperature below the glass transition temperature (Tg) of polystyrene.

 : Rubber block (EP)

$\left(\underset{\text{C}}{\text{C}} - \text{C} - \text{C} - \text{C} \right)_n$ Acts as an origin of rubber-like properties. Having no unsaturated bond shows excellent heat resistance and weatherability.

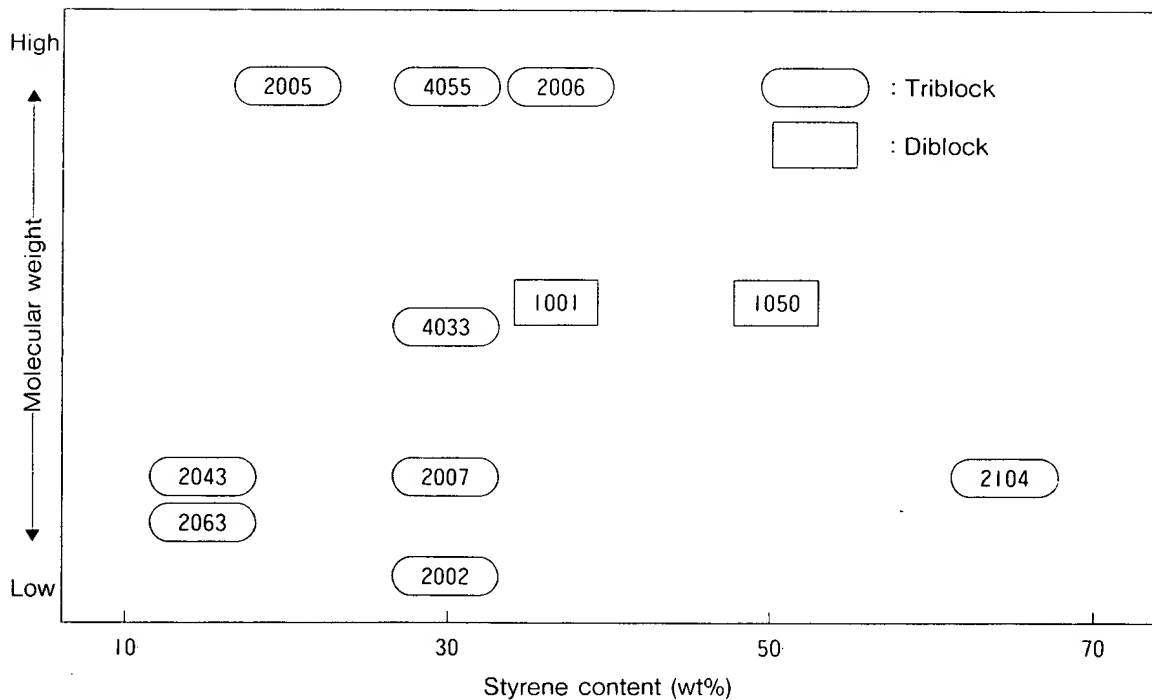


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CHARACTERISTICS of "SEPTON"

- ① Thermoplastic rubber.
- ② Excellent elasticity and tensile strength without vulcanization.
- ③ Excellent heat aging resistance.
- ④ Excellent weather resistance.
- ⑤ Excellent properties at low temperature
(T_g of a rubber block: -53°C).
- ⑥ Excellent affinity with olefinic or styrenics.
- ⑦ Excellent electrical characteristics (insulation properties).
- ⑧ Excellent in a chemical resistance (to acids, alkalis and alcohols).
- ⑨ Low density (<0.95).
- ⑩ Low toxicity.

GRADES of "SEPTON"



TYPICAL PROPERTIES OF "SEPTON"

Grade		1001	1050	2002	2007	2104	
Type		SEP	SEP	SEPS	SEPS	SEPS	
Styrene content [wt%]		35	50	30	30	65	
Specific gravity		0.92	0.91	0.92	0.92	0.97	
Hardness (JIS A)		80	97	80	80	98	
100% modulus [MPa] [kgf/cm ²]		— —	— —	3.8 39	3.7 38	— —	
Tensile strength [MPa] [kgf/cm ²]		2.0 20	2.9 30	11.8 120	23.5 240	4.3 44	
Elongation [%]		< 100	< 100	580	700	< 100	
MFR 230°C 2.16kg [g/10 min.] 200°C 10kg [g/10 min.]		— 1	0.08 0.5	70 100	2.4 4	0.4 22	
Solution viscosity 5wt% [mPa・S] 10wt% [mPa・S] 15wt% [mPa・S]		— 70 1220	— 70 720	— — 25	— 17 70	— — 23	
Physical form		Pellet	Pellet	Pellet	Pellet	Pellet	
Net weight [kg/bag]		20	20	20	20	20	
Safety	MHW ¹	○	—	○	○	—	
	PL ²	—	—	—	—	[B]NM-1524	
	BGA ³	○	—	—	○	—	
	FDA ⁴	—	—	—	—	—	

Unit conversion: 1MPa=10.20 kgf/cm², 1mPa·S=1cPs

¹ MHW : Bulletin No.20, The Ministry of Health and Welfare, Japan

² PL : Positive list issued by Japan Hygienic Olefin and Styrene Plastics Association, Japan, adapted to be used with

³ BGA : Standard food storage and packaging, recommended by BGA (Bundesgesundheitsamt), F.R. Germany

⁴ FDA : Amendment to the Section 177.1810 of the Food Additive Regulations, U.S.A.

B

<Tested by KURARAY>

	2063	2043	4033	2005	2006	4055	Measurement method
	SEPS	SEPS	SEPS	SEPS	SEPS	SEPS	—
	13	13	30	20	35	30	—
	0.89	0.89	0.92	0.90	0.92	0.92	JIS K-7112
	36	38	76	—	—	—	JIS K-6301
	0.4 4.1	0.5 5.1	3.7 38	— —	— —	— —	JIS K-6301
	10.8 110	11.8 120	39.2 400	— —	— —	— —	JIS K-6301
	1200	1110	570	—	—	—	JIS K-6301
	7 22	4 14	0.05 0.06	No flow	No flow	No flow	JIS K-7210
	— 29 140	— 32 150	— 50 390	28 1200 —	27 1220 —	90 5800 —	Toluene solution, 30°C
	Pellet	Pellet	Crumb	Crumb	Crumb	Crumb	—
	20	20	12	12	12	12	—
	○	○	—	○	○	—	—
	—	[B]NM-1525	—	—	—	[B]NM-1526	—
	—	—	○	○	○	○	—
	—	—	⊖	—	—	⊖	—

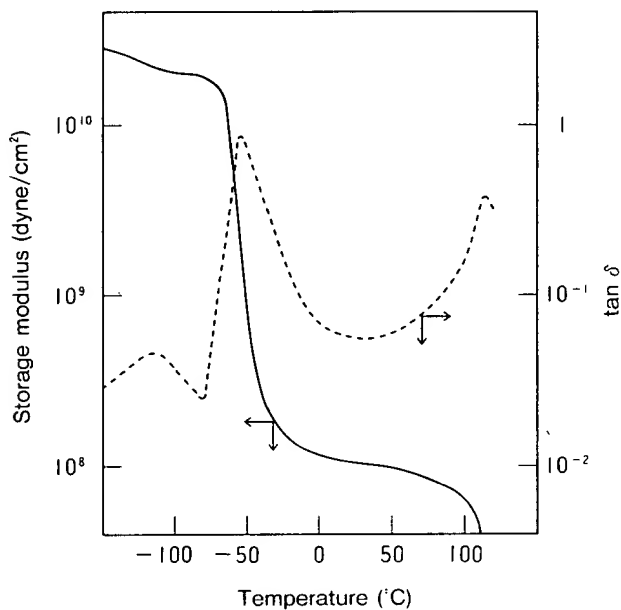
with PE, PP and PS, food packaging materials except for oily and fatty foods

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BASIC CHARACTERISTICS of "SEPTON"

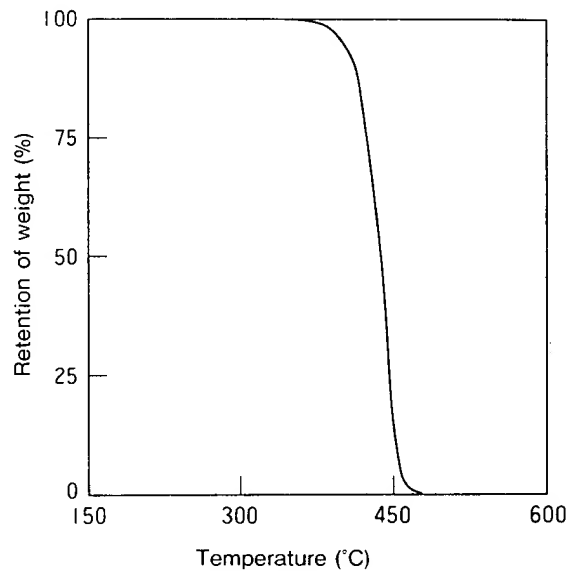
(Tested by KURARAY)

[1] DYNAMIC VISCOELASTIC BEHAVIOR



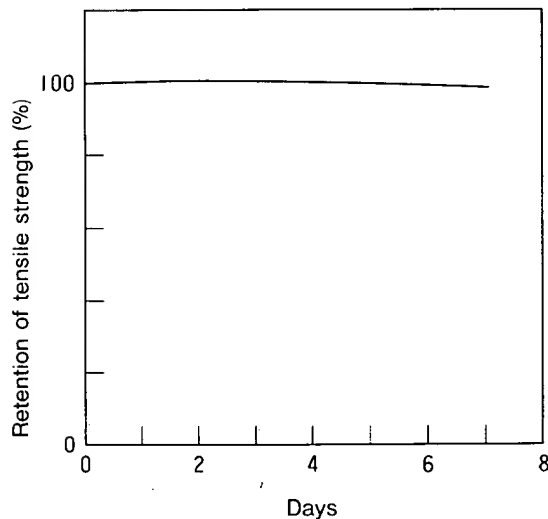
Test conditions : RHEOVIBRON DDV-III
Tensile mode
Heating rate : 3°C/min.
Frequency : 11Hz
SEPTON2007

[2] HEAT RESISTANCE



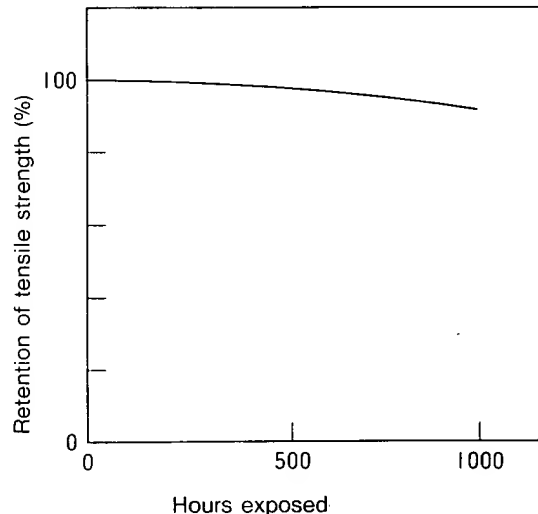
Test conditions : Thermobalance heat degradation
Heating rate : 10°C/min.
Under a nitrogen atmosphere
SEPTON2063

[3] HEAT AGING RESISTANCE



Test conditions : Geer oven at 120°C
SEPTON2007

[4] WEATHER RESISTANCE



Test conditions : Xenon arc weatherometer
Black panel temperature : 63±3°C
Light and dark cycle : continuous lighting
Spray cycle : 18min. during 120min.
SEPTON2007 (weatherably formulated)

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[5] ELECTRICAL PROPERTIES

Item	Grade	2043
Dielectric constant	50 Hz	2.31
	10 ³ Hz	2.31
	10 ⁶ Hz	2.31
Dielectric loss tangent	50 Hz	0.0002
	10 ³ Hz	0.0002
	10 ⁶ Hz	0.0008
Dielectric breakdown voltage	kV/mm	23.0
Volume resistivity	$\Omega \cdot \text{cm}$	3.0×10^{16}

Test conditions : JIS K-6911

Dielectric breakdown voltage: voltage rising rate
1kV/sec., electrode 25mm ϕ plate (measured in
insulating oil)

Volume resistivity: measured 1min. after applying
DC500V at 20°C

[6] COMBUSTION TEST

	Amount formed (mg/g)	Detection limit (mg/g)
Combustion gas		
SOx (reduced to SO ₂)	not detected	1
NOx (reduced to NO ₂)	not detected	1
HCl	not detected	0.05
HCN	not detected	0.005
NH ₃	not detected	0.05
CO	1.1	0.5
CO ₂	2,900	20
Gross calorific value (Cal/g)	10,800	

Test conditions : Combustion gas was analyzed in accordance with JIS K-7217.

Gross calorific value: Nekken type automated gas cylinder calorimeter
SEPTON2002

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APPLICATION OF "SEPTON" [1]

— COMPOUNDS —

When blended with polyolefin and process oil, "SEPTON" affords soft compounds suitably replaceable for vulcanized rubbers.

Examples of the formulations and physical properties.

<Tested by KURARAY>

	1	2	3
Formulation			
SEPTON4055	100	100	100
Polypropylene	75	50	25
Process oil	120	120	120
Anti-oxidizing agent [parts by wt.]	0.3	0.3	0.3
MFR 230°C, 2.16kg [g/10 min.]	10	2.9	0.1
Hardness (JIS A)	76	64	45
Mechanical properties			
100% modulus [MPa]	3.1	2.2	0.9
300% modulus [MPa]	4.2	3.1	1.6
Tensile strength [MPa]	15.2	10.8	7.4
Elongation [%]	790	790	850
Permanent set (100% × 10min.) [%]	16	10	5
Compression set (70°C × 22hr.) [%]	48	39	29

Mixing conditions : Twin screw extruder, 230°C, 200rpm.

(1MPa = 10.20kgf/cm²)

Molding : Injection molding



Examples of practical use of "SEPTON" compounds

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APPLICATION OF "SEPTON" [2]

— ADHESIVES —

When blended with tackifier and process oil, "SEPTON" affords adhesives having excellent heat resistance and weather resistance.

Solubility of "SEPTON"

Poorly or non soluble to : ethyl acetate, methyl ethyl ketone, methanol, ethanol, acetone, water

Well soluble to : petroleum ether, toluene, benzene, hexane, cyclohexane, chloroform, tetrachloromethane, carbon disulfide

Tackifiers compatible with "SEPTON"

Rubber phase : alicyclic saturated hydrocarbon resins, hydrogenated terpene resins, terpene resin, aromatically modified terpene resins, paraffinic petroleum resin, hydrogenated rosin esters

Styrene phase : aromatic resins, styrenic resins

Examples of formulations and physical properties of the hot-melt adhesives

<Tested by KURARAY>

	1	2	3	4	5
Formulation					
SEPTON2043	100	100	100	100	100
Alicyclic saturated hydrocarbon resin	100	100	100	150	150
Paraffinic process oil	20	50	100	20	50
Anti-oxidizing agent [parts by wt.]	1	1	1	1	1
Properties					
Tack : rolling ball-tack test [ball No.]	7	13	7	<3	8
Cohesion : creep test					
holding power [min.]	>240	>240	>240	>240	>240
slippage [mm]	0.07	0.1	1.0	0.1	0.2
Adhesion : 180° peel test					
to stainless steel [g/cm]	950	560	350	1630	970
to PE [g/cm]	480	300	140	620	480

Test conditions : thickness : coating/substrate=30 μ m/50 μ m PET film

rolling ball-tack test : measured at 25°C

creep test : 25mm \times 25mm load 1kg at 40°C

180° peel test : rate of peel=300mm/min. at 25°C

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APPLICATION OF "SEPTON" [3]

— PLASTICS MODIFICATION —

When blended with olefinic plastics, "SEPTON" improves various physical properties including impact strength. "SEPTON" also acts as a compatibilizer between polyolefins and styrenic.

[1] Modification of polypropylene

<Tested by KURARAY>

	1	2	3	4
PP (block) SEPTON2002 [parts by wt.]	100 —	90 10	80 20	70 30
MFR 230°C, 2.16kg [g/10min.]	29	30	34	36
Izod impact strength notched 25°C [J/m]	120	200	629	673
notched -20°C [J/m]	70	86	170	680
Flexural modulus [MPa]	858	741	615	540

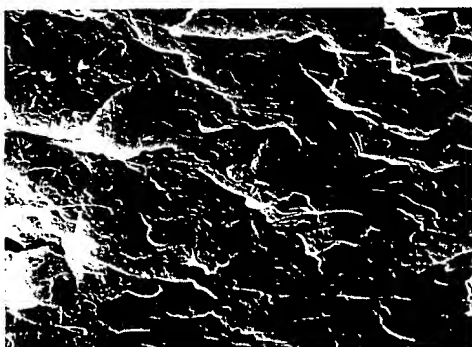
(1J/m = 0.102kgfcm/cm)
(1MPa = 10.20kgf/cm²)

[2] Compatibilizer

<Tested by KURARAY>

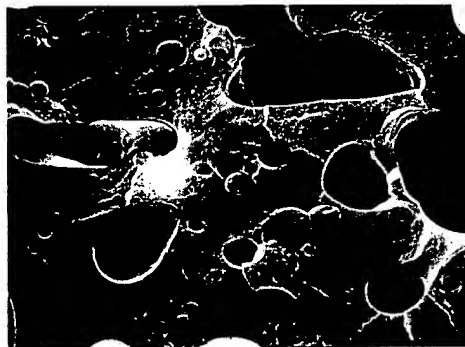
	1	2
ABS PP SEPTON2104 [parts by wt.]	70 30	70 30 5
Izod impact strength notched 25°C [J/m]	49	88
unnotched 25°C [J/m]	167	549
Flexural modulus [MPa]	2040	1980

(1J/m = 0.102kgfcm/cm)
(1MPa = 10.20kgf/cm²)



ABS/PP/SEPTON Blend

1 μm



ABS/PP Blend

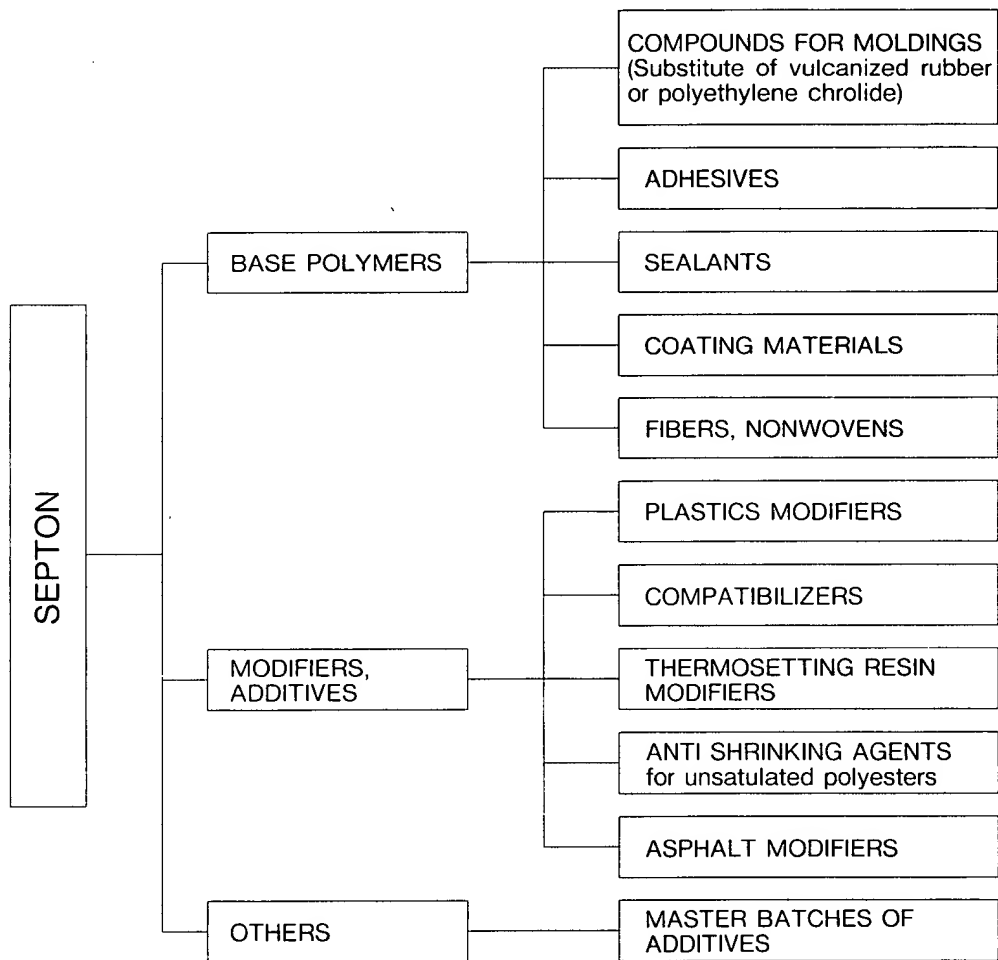
1 μm

Scanning Electron Micrograph (×1000)

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USES of "SEPTON"

Based on its excellent basic characteristics and versatile grades, "SEPTON" is applied to wide variety of industrial uses such as compounds for various moldings, base polymers for adhesives and plastics modifiers.



All data presented herein is based on actual measurements performed by Kuraray Co., Ltd.
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Tokyo : Maruzen Bldg., 2-3-10, Nihonbashi, Chuo-ku, Tokyo 103 TEL(03)3277-6654, FAX(03)3277-6666
Osaka : Shin-Hankyu Bldg., 1-12-39, Umeda, Kita-ku, Osaka 530 TEL(06)348-2551, FAX(06)348-2025
Kashima Plant : 36, Towada, Kamisu-cho, Kashima, Ibaraki Prefecture 314-02 TEL(0299)96-1337, FAX(0299)96-3243